National Institute of Environmental Health Sciences

Past and future changes in Canadian boreal wildfire activity

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Abstract:

Climate change in Canadian boreal forests is usually associated with increased drought severity and fire activity. However, future fire activity could well be within the range of values experienced during the preindustrial period. In this study, we contrast 21st century forecasts of fire occurrence (FireOcc, number of large forest fires per year) in the southern part of the Boreal Shield, Canada, with the historical range of the past 240 years statistically reconstructed from tree-ring width data. First, a historical relationship between drought indices and FireOcc is developed over the calibration period 1959-1998. Next, together with seven tree-ring based drought reconstructions covering the last 240 years and simulations from the CGCM3 and ECHAM4 global climate models, the calibration model is used to estimate past (prior to 1959) and future (post 1999) FireOcc. Last, time-dependent changes in mean FireOcc and in the occurrence rate of extreme fire years are evaluated with the aid of advanced methods of statistical time series analysis. Results suggest that the increase in precipitation projected toward the end of the 21st century will be insufficient to compensate for increasing temperatures and will be insufficient to maintain potential evapotranspiration at current levels. Limited moisture availability would cause FireOcc to increase as well. But will future FireOcc exceed its historical range? The results obtained from our approach suggest high probabilities of seeing future FireOcc reach the upper limit of the historical range. Predictions, which are essentially weighed on northwestern Ontario and eastern boreal Manitoba, indicate that, by 2061-2100, typical FireOcc could increase by more than 34% when compared with the past two centuries. Increases in fire activity as projected by this study could negatively affect the implementation in the next century of forest management inspired by historical or natural disturbance dynamics. This approach is indeed feasible only if current and future fire activities are sufficiently low compared with the preindustrial fire activity, so a substitution of fire by forest management could occur without elevating the overall frequency of disturbance. Conceivable management options will likely have to be directed toward minimizing the adverse impacts of the increasing fire activity.

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Resource Description

Climate Scenario :

specification of climate scenario (set of assumptions about future states related to climate)

Special Report on Emissions Scenarios (SRES), Other Climate Scenario

Special Report on Emissions Scenarios (SRES) Scenario: SRES A1, SRES A2, SRES B1, SRES

B2

Other Climate Scenario: SRES A1B

Exposure :

weather or climate related pathway by which climate change affects health

Extreme Weather Event

Extreme Weather Event: Wildfires

Geographic Feature:

resource focuses on specific type of geography

Other Geographical Feature

Other Geographical Feature : boreal forest

Geographic Location:

resource focuses on specific location

Non-United States

Non-United States: Non-U.S. North America

Health Impact:

specification of health effect or disease related to climate change exposure

Health Outcome Unspecified

Mitigation/Adaptation:

mitigation or adaptation strategy is a focus of resource

Adaptation

Model/Methodology:

type of model used or methodology development is a focus of resource

Exposure Change Prediction

Resource Type:

format or standard characteristic of resource

Research Article

Resilience:

capacity of an individual, community, or institution to dynamically and effectively respond or adapt to shifting climate impact circumstances while continuing to function

A focus of content

Timescale:

time period studied

Long-Term (>50 years)

Vulnerability/Impact Assessment: ☑

resource focus on process of identifying, quantifying, and prioritizing vulnerabilities in a system

A focus of content